Sub-20 nm patterning of thin layer WSe2 by scanning probe lithography

A.I. Dago, Y.K. Ryu, R.Garcia
Instituto de Ciencia de Materiales de Madrid (ICMM-CSIC), Madrid, Spain

E-mail: arancha.iglesias@csic.es

Transition metal dichalcogenides (TMDs) have been broadly studied as promising materials for the development of advanced electronic, optoelectronic and sensing devices. Their electronic properties together with their mechanical flexibility and their optical transparency have caught the attention of the scientific community in recent years [1]. However, some restrictions need to be overcome so that these materials become viable materials for the fabrication of semiconductor devices [2]. For instance, reliable lithographic techniques are needed with which to control the width of the devices in the nanometric scale.

Oxidation scanning probe lithography (o-SPL) has been applied for the nanopatterning of molibdenum disulfide (MoS_2) [3]. Here we report the sub-30 nm patterning of tungsten diselenide (WSe_2) thin layers by o-SPL (Fig.1a) and its application to the fabrication of a WSe_2 nanoscale field-effect transistor (FET). The electronic properties of the device were not degraded during the patterning procedure (Fig. 1b). The fabricated WSe_2 nano-transistor has been used as a nanoscale humidity sensor [4].

We acknowledge support from the European Union under Grant Agreement No. 318804 (SNM).

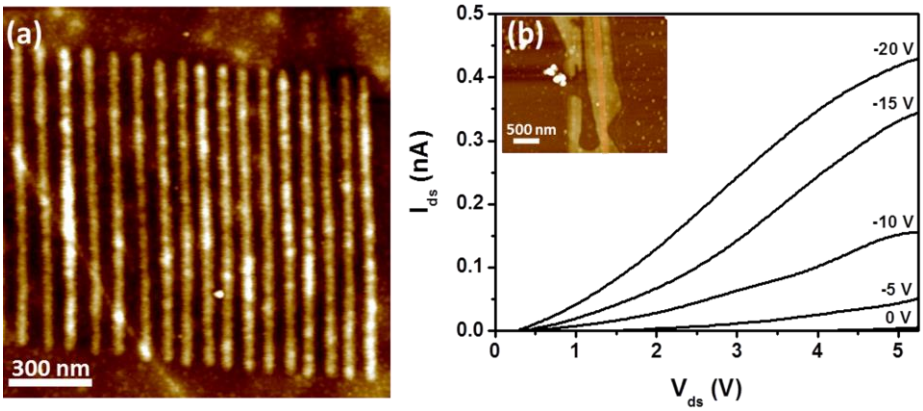

Figure 1. (a) Nanopatterns on WSe_2 fabricated by o-SPL. AFM topographic image of an array of lines separated 80 nm. (b) Output curves of a WSe_2 nano-FET measured in ambient conditions. Inset shows an AFM topographic image of the measured WSe_2 nano-FET.

References

1. G. Fiori, F. Bonaccorso, G. Iannaccone, T.Palacios, D.Neumaier, A. Seabaugh, S.K. Banerjee and L. Colombo, Nat. Nanotechnol. 9, 768-779 (2014)
2. X.Duan, C. Wang, R. Yu and X.Duan, Chem. Soc. Rev. 44, 8859-8876 (2015)
3. F.M. Espinosa, Y.K. Ryu, K. Marinov, D. Dumenco, A. Kis and R. Garcia, Appl. Phys. Lett. 106, 103503 (2015)
4. A.I. Dago, Y.K. Ryu and R.Garcia, submitted to Nanotechnology (2016)